RESTRICTED CIRCULATION

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Agricultural Memorandum No 810

Minimum temperature measurements in the vicinity of a sheep house.

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Summary

As part of a survey into lamb mortality prior to weaning, carried out at Bradfield Farm near Reading in cooperation with the veterinary unit of South-east ADAS, measurements of the minimum temperature regime were made in the vicinity of a modern, open-structured building where 400 pregnant ewes were overwintered.

Introduction

Farm livestock can be affected by climate both indirectly in its influence upon the availability of food and directly as a result of exposure to climate rigours (Blaxter 1962).

Grazing stock, however, are not entirely at the mercy of the environment; their mobility means shelter may be sought and the influence of the close community of the flock can ameliorate the microclimate for the individual animal. While the temporary use of shelter by ewes and lambs has been noted to be a major contributory factor in reducing neo-natal lamb deaths (Egan et al 1972), the housing of stock can result in severe problems such as pregnancy toxaemia, pneumonia and the rapid spread of infectious diseases. Penned stock can neither 'huddle' under cold conditions nor escape the deleterious effects of draughts or stagnant air.

Thus the quality of the housing environment is all important and cannot be isolated from the external meteorological conditions (Smith CV, 1972).

Measurements at Bradfield

The sheep housing was situated on a south facing slope leading down to the River Pang (near 'Owl Pit' in fig 1, Ag. Mem. 809).

It was evident from an initial inspection (in January 1976) that under

radiation conditions the housing area would be prone to katabatic drainage from the 1 in 17 slope to the north (fig 1); further, the arrangement of straw bales to a height of several metres around the perimeter of the housing could well encourage the retention of cold air within the structure.

A chain of minimum thermometers, exposed at 1.1m above the ground in a 'cocoa-tin' arrangement, was established within, and in the vicinity of, the housing (see fig 1). Temperature fluctuations within the housing were monitored by a thermograph close to the minimum thermometer 'D'.

During the period late January to the end of May 1976 some 25 nights with sub-zero temperatures at 1.1m were registered by the thermometer chain (table 1); 15 of these occasions were classified as being under radiation conditions. The two lowest temperatures recorded within the housing were -5.5°C (night of March 1/2) and -4.5°C (March 9/10). Table 2 presents the mean and standard deviation of differences of temperature from Site A at each of the other sites in the chain. The housing gives rise to an amelioration of about 1°C over ambient (the exposure of thermometer E was close to a concrete path and depressed minima might be anticipated). The elevation of temperature within the housing persisted on radiation nights <u>after</u> the sheep had been removed and hence must be considered to be mainly due to radiative effects induced by the thermal capacity of the housing structure rather than the heat source effect of the 400 ewes.

Thermograph traces agreed well with the minimum temperatures registered by the nearby minimum thermometer. They indicated 9 occasions when temperatures within the housing changed by over 15°C in 12 hours or less (the lowest temperature being below zero). A 17°C rise from -5°C in 8 hours was registered on 8 April and on 2 March a rise from -5 to +12½°C occurred in 6½ hours. Correspondingly large temperature falls generally took place over 12 hours or more.

[There is evidence (eg L P Smith Ag Mem 545) that sharp changes in temperature can influence the incidence of acute respiratory disease, especially if a second such period coincides with the incubation period of the pathogen].

Subsequent measurements are planned this winter with straw bales stacked on the escarpment to the north of the housing to steer the katabatic flow around the sides of the housing. Cold air drainage from within the housing will be encouraged by opening up gaps in the straw-bale barrier around the southern perimeter.

Any comments or suggestions on this paper should be referred to the author.

Meteorological Office

Bracknell

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References

Blaxter K L 1962. The energy metabolism of ruminants. Hutchinson Publ. Co., London.

Egan J.K. McLaughlin J W Thompson R.L & McIntyre J S (1972) The importance of shelter in reducing neo-natal lamb deaths. Austr.Journ.Exp. Agric. Anim Husbandry 12, 470-473

Smith C V (1972) Some environmental problems of livestock housing . WMO Technical Note 122.

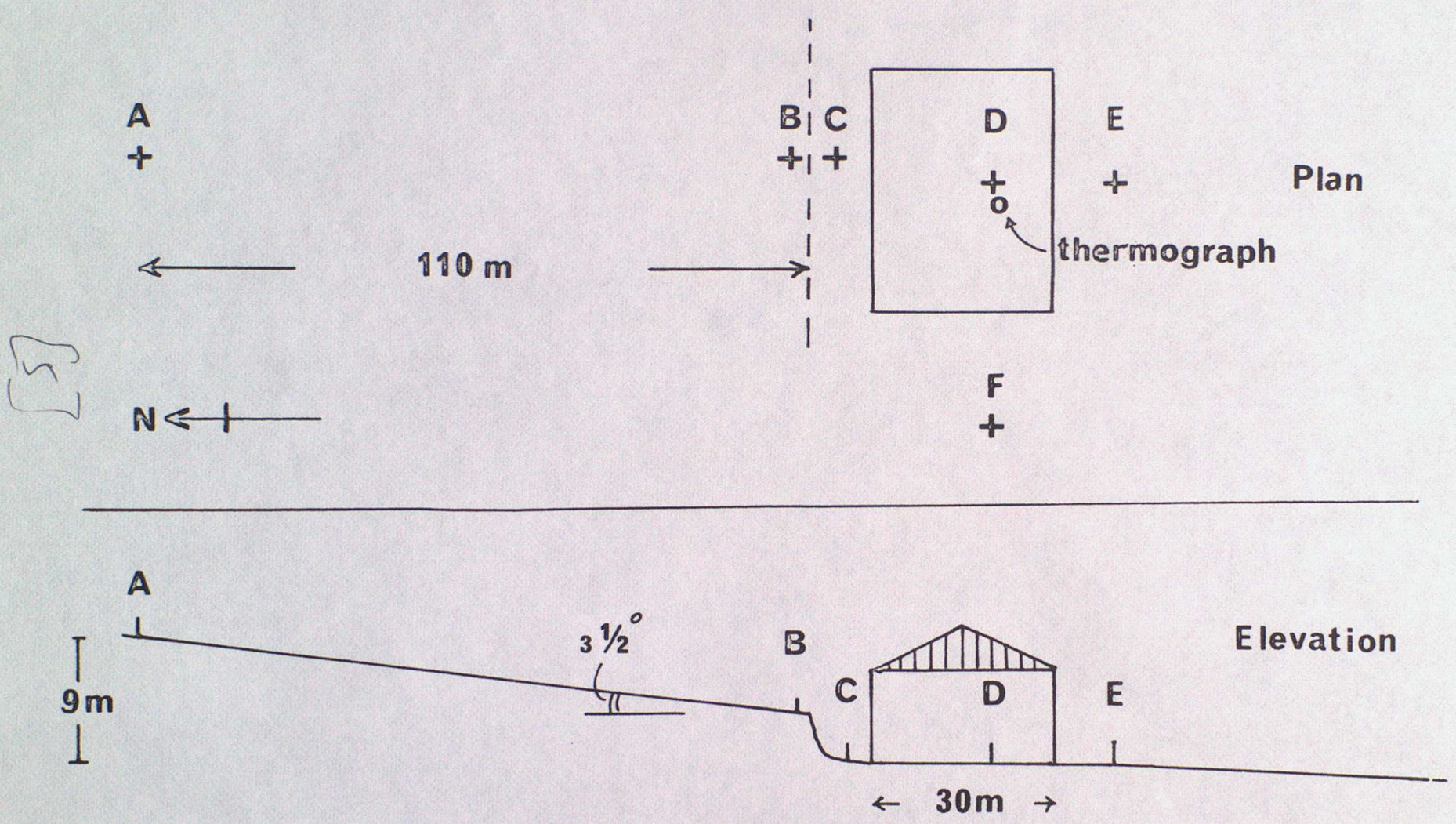

Fig 1

Table I

Bradfield Farm: 'Cocoa-Tin' Minimum Temperatures Measured in the Vicinity of the Sheep Housing

		A	B	C	D within house	E	F
February	11	1.0	1.6	1.6	2.0	1.2	
	12	0.5	2.1	2.1	2.3	2.0	
	13	4.4	4.4	4.5	3.0	4.4	
	14						
	15						
	16	- 1.3	- 1.2	- 1.2	0.0	- 1.7	- 0.9
	17						
	18	0.5	0.5	0.6	1.2	0.5	0.5
	19	0.0	0.1	- 0.1	1.4	- 0.1	0.0
	20	1.3	1.1	- 0.1	1.3	- 0.8	- 1.0
	21	4.5	4.5	4.5	5.6	4.5	4.3
	22	4.8	4.9	5.2	7.1	6.5	6.6
	23	6.6	7.0	7.0	8.5	8.5	8.6
	24	8.5	8.7	9.0	8.5	8.5	8.6
	25	5.9	6.1	6.3	6.5	6.0	6.0
	26	8.5	8.7	9.0	8.5	8.5	8.6
	27	6.4	6.4	6.5	7.6	6.4	6.5
	28	4.8	5.0	5.1	5.7	4.9	5.0
	29	2.9	3.4	3.5	4.4	2.5	2.7
March	1	- 1.9	- 2.0	- 2.0	- 0.9	- 2.0	- 2.2
	2	- 4.8	- 5.6	- 5.6	- 5.5	- 6.6	- 5.9
	3						
	4	- 2.0	- 2.8	- 2.9	- 1.5	- 3.6	- 3.2
	5	- 4.8	- 5.0	- 4.9	- 3.5	- 5.5	- 5.0
	6	- 1.7	- 2.6	- 2.7	- 1.9	- 3.0	- 3.4
	7	- 2.8	- 2.8	- 3.7	- 1.5	- 3.1	- 2.2
	8	- 2.3	- 2.0	- 2.1	- 0.7	- 3.0	- 1.7
	9	- 5.3	- 5.6	- 5.9	- 4.2	- 6.2	- 6.0
	10	- 5.8	- 6.0	- 6.0	- 4.5	- 6.6	- 6.0
	11	0.0	- 0.2	- 0.2	0.6	0.5	0.0
	12	3.7	3.5	3.9	4.5	3.5	3.7
	13	2.5	2.2	2.4	3.4	2.0	2.5
	14	1.7	2.0	1.9	3.0	2.0	2.1
	15	0.6	0.1	- 0.4	1.2	- 0.2	- 0.5
	16	3.4	3.9	3.6	4.8	3.7	4.0
	17	- 1.4	- 1.0	- 0.9	0.0	- 1.2	- 1.0
	18	3.6	4.2	4.9	5.0	3.5	3.3
	19	0.2	0.0	0.5	1.6	0.5	1.0
	20	0.8	0.6	0.3	1.9	0.8	2.1
	21						
	22	1.3	0.8	0.6	-	0.8	1.2
	23						
	24	-	- 4.4	- 4.5	- 3.1	- 5.3	- 4.8
	25						
	26	3.0	2.3	2.0	2.2	3.0	3.0
	27						
	28						
	29	3.3	3.2	3.0	3.3	2.6	2.7
	30						
	31	4.1	4.6	4.1	4.7	3.7	3.9

		A	B	C	D	E	F
April	1						
	2	6.6	6.5	6.1	6.7	6.0	6.2
	3						
	4						
	5	- 1.4	- 0.6	- 1.1	0.2	- 1.4	- 1.0
	6						
	7	3.7	3.3	2.5	4.3	3.1	3.2
	8						
	9	- 4.4	- 4.8	- 5.6	- 4.1	- 5.9	-5.0
	10						
	11						
	12	- 0.4	- 1.4	- 1.4	- 0.3	- 2.1	- 1.0
	13						
	14	0.4	0.0	0.0	0.8	- 0.5	0.0
	15						
	16						
	17						
	18						
	19	- 1.8	- 2.1	- 2.0	- 1.1	- 2.4	- 2.0
	20						
	21	2.6	2.4	2.2	3.2	1.8	2.1
	22	5.5	5.6	5.5	5.9	5.6	5.7
	23	- 0.2	0.0	- 0.5	0.6	0.0	0.2
	24	- 0.3	0.1	- 0.5	1.0	0.1	0.3
	25	2.0	3.0	1.2	3.0	1.6	2.3
	26	3.8	3.2	4.4	4.4	3.9	4.0
	27	5.2	5.4	5.8	4.5	5.5	5.6
	28	- 1.8	- 2.1	- 2.3	- 1.6	- 2.8	- 2.8
	29	- 4.5	- 4.8	- 4.5	- 4.4	- 5.5	- 4.6
	30	4.8	4.5	4.6	2.6	4.4	4.1
May	1	- 1.8	- 2.3	- 2.0	- 0.6	- 2.5	- 2.3
	2	5.8	5.9	6.2	5.0	6.1	5.8
	3	7.4	7.8	7.7	8.0	7.6	7.4
	4	5.2	6.0	6.2	6.4	5.8	5.6
	5	7.0	8.1	8.1	8.5	7.5	7.2
	6	9.8	8.8	8.2	8.4	9.0	8.3
	7	5.0	4.8	4.8	5.5	4.0	4.0
	8	7.8	7.5	7.8	8.2	6.7	6.9
	9	10.4	9.8	10.0	10.5	9.3	9.3
	10	10.6	11.0	-	11.5	11.0	10.5
	11	1.5	1.6	1.7	3.0	1.0	1.5
	12	6.5	7.2	7.3	7.5	6.2	6.2
	13	4.0	5.0	5.2	6.0	4.0	4.5
	14	- 0.4	- 0.4	0.0	- 1.0	- 1.2	- 0.5
	15	1.2	0.7	0.0	1.0	0.0	0.5
	16	2.8	3.3	3.5	4.7	2.9	3.3

Date is that on which thermometers were read, normally at 0730 to08.00 local time.

Table 2

Mean and standard deviation of differences of minimum temperatures, ΔT_m, at sites B, C, D, E & F from those at A on radiation nights.

Site	A	B	C	D	E	F
ΔT_m °C.	0	-0.4	-0.5	+0.6	-1.1	-0.6
Standard deviation $\begin{pmatrix}+\\-\end{pmatrix}$	/	0.3	0.4	0.4	0.5	0.4

(A negative value signifies a site minimum below that at A)